Reactive transport modeling to quantify trace element release into fresh groundwater in case of CO2 leak from deep geological storage.

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Geological storage of CO_2 in deep saline aquifers is one of the options considered for the mitigation of CO_2 emissions into the atmosphere. A deep geological CO_2 storage is not expected to leak but potential impacts on groundwater have to be studied. A better understanding on how it could affect groundwater quality, aquifer minerals and trace elements is necessary to characterize a future storage site. Moreover, monitoring and remediation solutions have to be evaluated before storage operations. As part of the ANR project CIPRES, we present here reactive transport works.

In a 3D model using ToughReact v.2, we perform different CO_2 leakage scenarios in a confined aquifer, considering CO_2 gas leakage. The model is based on the Albian aquifer, a strategic water resource. It takes into account groundwater and rock chemistry of the Albian green sand layer (Quartz, Glauconite, Kaolinite) at 700 m deep. The geochemical model was elaborated from experimental data. The aquifer consists in a mesh, divided roughly in 20000 cells making a 60 m thick and a 500 m large layer. Furthermore, cells are subdivided near the leakage point to consider local phenomena (secondary precipitation, sorption/desorption...). The chemical model takes into account kinetics for mineral dissolution, ion exchange and surface complexation.

We highlight the importance of sorption processes on trace element transport (As, Zn and Ni) in fresh groundwater. Moreover, we distinguish different geochemical behavior (CO_2 plume shape, secondary precipitation, desorption...) according to different horizontal flow rates influenced by the hydrodynamics (regional gradient). Understanding how geochemical processes and regional flows influence water chemistry, allows to ascertain measurement monitoring and verification plan and remediation works in case of leak considering a given location.

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